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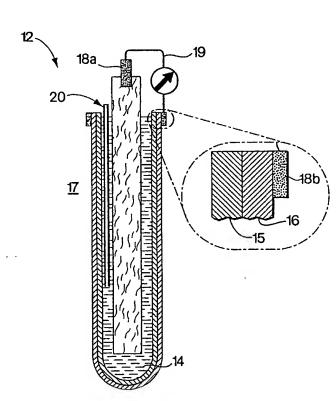
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(54) Title: AN ELECTROCHEMICAL DEVICE AND METHODS FOR ENERGY CONVERSION



(57) Abstract: The present invention relates to an electrochemical device. The device features an anode constructed of materials such that the device can be chemically recharged. In addition, the device is capable of switching between operating as a fuel cell or as a battery. The switch can occur without cessation of electrical output. In certain aspects of the invention, the device is capable of operating at a temperature of less than 1000 °C. Other aspects feature a liquid anode which allows higher output, dispersion of fuel and minimal stresses in an interface comprising the anode. Preferably the anode is a liquid at a temperature of less than 1000 °C. The invention also relates to methods for energy conversion in which a continual electrical output can be produced in both the presence of fuel without anode consumption or the absence of fuel.

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A. CLASSI IPC 7	FICATION OF SUBJECT MATTER H01M16/00				
According to	o International Patent Classification (IPC) or to both national classific	cation and IPC			
B. FIELDS	SEARCHED				
Minimum de IPC 7	ocumentation searched (classification system followed by classification ${\tt H01M}$	tion symbols)			
Documenta	tion searched other than minimum documentation to the extent that	such documents are included in the fields s	earched		
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C. DOCUM	ENTS CONSIDERED TO BE RELEVANT		,		
Category *	Citation of document, with indication, where appropriate, of the re	elevant passages	Relevant to claim No.		
X	DE 40 04 220 C (KOCH, H H) 18 April 1991 (1991-04-18) the whole document	-/ 	1-4, 9-11,14, 21-28, 30, 33-36, 44,45, 49, 52-59, 74,83, 84, 87-93, 102-108, 110-113		
X Furth	ner docurrents are listed in the continuation of box C.	X Patent family members are listed	in annex.		
filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but		or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention or document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is taken alone annot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.			
Date of the	actual completion of the international search	Date of mailing of the international sea	rch report		
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Name and mailing address of the ISA European Patent Office, P.B. 5818 Patenttaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer Riba Vilanova, M			

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PCT/US 01/12616

	stion) DOCUMENTS CONSIDERED TO BE RELEVANT	Relevant to alaim bla
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 970 474 A (ANBAR MICHAEL ET AL) 20 July 1976 (1976-07-20) the whole document	1-4,9, 10, 23-33, 35,36, 44,45, 52-59, 74,83, 84, 87-93, 102-108, 110-113
χ .	DE 26 50 960 A (US COMMERCE)	1-4,9,
	18 May 1977 (1977-05-18) the whole document	10, 23-33, 35,36, 44-48, 52-59, 74,83, 84, 87-93, 102-108, 110-113
Α	YENTEKAKIS I V ET AL: "A NOVEL FUSED	1-113
	METAL ANODE SOLID ELECTROLYTE FUEL CELL FOR DIRECT COAL GASIFICATION: A STEADY-STATE MODEL" INDUSTRIAL & ENGINEERING CHEMISTRY RESEARCH, AMERICAN CHEMICAL SOCIETY. WASHINGTON, US, vol. 28, no. 9, 1 September 1989 (1989-09-01), pages 1414-1424, XP000114234 ISSN: 0888-5885 passage "The Process", pages 1414-1415 figure 1	
A	GB 2 278 010 A (AGENCY IND SCIENCE TECHN) 16 November 1994 (1994-11-16) claims figures	1-113
A	FR 2 020 742 A (SIEMENS AG; VARTA AG) 17 July 1970 (1970-07-17) claims	1-113
A	GB 1 276 260 A (DEUTSCHE AUTOMOBILGESELLSCHAFT MBH) 1 June 1972 (1972-06-01) claims figures	1-113

* TERNATIONAL SEARCH REPORT

in stional Application No
PCT/US 01/12616

.(Continu	Inuation) DOCUMENTS CONSIDERED TO BE RELEVANT					
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.				
	FR 2 207 365 A (RHEIN WESTFAEL ELECT WERK AG) 14 June 1974 (1974-06-14) claims figures	1-113				
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' TERNATIONAL SEARCH REPORT

Information on patent family members

in ational Application No

				<u> </u>	
Patent document cited in search report		Publication date		Patent family member(s)	Publication date
DE 4004220	С	18-04-1991	DE	4004220 C1	18-04-1991
US 3970474	А	20-07-1976	NONE	*****	
DE 2650960	Α	18-05-1977	US	4042755 A	16-08-1977
			CA	1067568 A1	04-12-1979
			DE	2650960 A1	18-05-1977
			FR	2331162 A1	03-06-1977
			GB	1536768 A	20-12-1978
			JP	52059827 A	17-05-1977
GB 2278010	Α	16-11-1994	JP	2560232 B2	04-12-1996
			JP .	6325769 A	25-11-1994
			US	6183896 B1	06-02-2001
FR 2020742	Α	17-07-1970	. DE	1803122 A1	21-05-1970
			FR	2020742 A5	17-07-1970
GB 1276260	Α	01-06-1972	DE	1934974 A1	09-06-1971
			FR	2054117 A5	16-04-1971
FR 2207365	Α	14-06-1974	BE	807473 A1	15-03-1974
			DD	107813 A5	12-08-1974
			FR	2207365 A1	14-06-1974
			JP	49135137 A	26-12-1974
			NL	7315773 A	21-05-1974